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EDITORIAL COMMENT

Taking the Last Hurdles: Magnetic Resonance Myocardial Perfusion Imaging*

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In this issue of *iJACC*, Doesch et al. (1) assess the prognostic value of magnetic resonance (MR) adenosine stress perfusion in patients with coronary lesions of ≥50% but ≤75%. This study closes an important gap in the decision-making process and may reduce the need for invasive hemodynamic studies in patients with intermediate stenoses.

The selection of patients with stable coronary artery disease (CAD) for invasive coronary angiography and revascularization and the prediction of the individual patient's risk of major cardiac events remain subjective and imprecise. Recent invasive studies, such as the DEFER (Deferral Versus Performance of PTCA in Patients Without Documented Ischemia) study have shown that revascularization does not improve the prognosis of

See page 424

patients with intermediate coronary artery stenosis, if the stenosis does not limit flow during stress (2). Usually, this is determined by measuring pressure proximal and distal to the stenosis using an intracoronary pressure wire (fractional flow reserve [FFR]). These single-center data have been reconfirmed in a multicenter setting in patients with multivessel disease, in the FAME (Fractional Flow Reserve Versus Angiography for Multivessel Evaluation) study (3). Among others, the COURAGE (Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation) trial has challenged the benefit of revascularizing patients with stable angina pectoris as a whole (4). A subgroup analysis of the COURAGE data in patients with single-photon emission computed tomography (SPECT) suggests that the prognosis of patients is correlated to their ischemic burden after optimal medical therapy (with or without revascularization) and the amount of ischemia reduction achieved by therapy (5). That is in line with a wealth of data demonstrating that the prognosis of patients is related to the presence of stress-induced myocardial ischemia using SPECT (6–10), stress echocardiography (11–14), or cardiac MR (15,16). Specific data on patients with intermediate stenoses, however, are lacking.

Over the past 3 decades, SPECT and positron emission tomography (PET) have dominated myocardial perfusion imaging in clinical practice on the basis of an extensive amount of research. However, these techniques have several important limitations, such as the occurrence of attenuation artifacts for SPECT, the application of radioactive tracers, and the limited availability of PET, which is considered the reference standard. MR myocardial perfusion imaging has been shown to be highly accurate for the assessment of myocardial ischemia and was noninferior to SPECT in a recent multicenter trial (17). One of the major advantages of MR perfusion imaging is its ability to visualize subendocardial perfusion defects, which is not possible with PET or SPECT owing to their lower spatial resolution. More recently, MR perfusion imaging has been validated against invasive hemodynamic measurements, resulting in good correlations with coronary flow reserve and acceptable correlations with FFR (18–20).

To date, less clinical outcome information is available from MR myocardial perfusion imaging in comparison to nuclear medicine, which has been used for >30 years. However, these data are becoming available. A recent study (8) of adenosine

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stress perfusion cardiac MR in patients with chest pain, negative troponin-I test results, and nondiagnostic electrocardiographic findings demonstrated a sensitivity of 100% and a specificity of 93% for the detection of future adverse cardiac outcomes. Patients with normal stress myocardial perfusion had no adverse cardiac events during 1 year of follow-up. In another study by Jahnke et al. (16), a negative perfusion study was related with 0.7%, 0.7%, and 2.3% cumulative event rate for the first 3 years, which was significantly lower than the event rate in patients with a positive MR myocardial perfusion study (6.2%, 12.2%, and 16.3% cumulative event rate for the first 3 years).

Doesch et al. (1) have followed up a group of 81 patients with stable angina and intermediate coronary artery lesions by invasive angiography for 30 ± 8 months. All patients were treated with optimal medical therapy independent of the MR findings. In the group of 36 patients without a defect on adenosine stress MR perfusion, no major cardiac event was found during a follow-up period of 30 ± 8 months. In contrast, in the group of 45 patients with a perfusion defect, 9 (20%) had an acute coronary syndrome. Despite not being used for clinical decision making, the presence of a stress-induced perfusion defect was associated with a significantly higher rate of revascularization (37.8% vs. 5.5%). The presence or absence of a perfusion defect correlated with symptoms at an early follow-up at 18 ± 8 months, but not at a late follow-up.

The study closes a growing gap. On one hand, revascularization should be restricted to patients with hemodynamically significant stenoses. Until now, the only evidence specifically for patients with intermediate stenoses was available for FFR, which either requires a second invasive procedure after the first diagnostic angiography, or a significant prolongation of the invasive study. On the other hand, the number of patients with a primary diagnosis based on multislice computed tomography is also increasing. For both groups, a noninvasive rapid test would be highly desirable. Based on the data from this study, we can now start using MR perfusion in this setting.

Future trials need to concentrate on several aspects. First, the data need to be reconfirmed in a larger group of patients, preferably in a multicenter setting. Second, it needs to be worked out whether an MR perfusion-guided strategy is superior to an MR blind strategy. Third, a direct comparison of an MR-guided strategy to an FFR-guided strategy needs to be performed.

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JACC: CARDIOVASCULAR IMAGING, VOL. 2, NO. 4, 2009
APRIL 2009:434–6

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